

(21) Application No 0124111.6

(22) Date of Filing 06.10.2001

(71) Applicant(s)  
**Ford Global Technologies, Inc.**  
(Incorporated in USA - Michigan)  
600 Parklane Towers East,  
One Parklane Boulevard, Dearborn,  
Michigan 48126-2490,  
United States of America

(72) Inventor(s)  
**Christopher Simmonds**  
**Christophe Bastien**  
**Keith William Distin**

(74) Agent and/or Address for Service  
**Land Rover Group Limited**  
**Warwick Technology Park, WARWICK,**  
**CV34 6RG, United Kingdom**

(51) INT CL<sup>7</sup>  
**B60R 21/34**

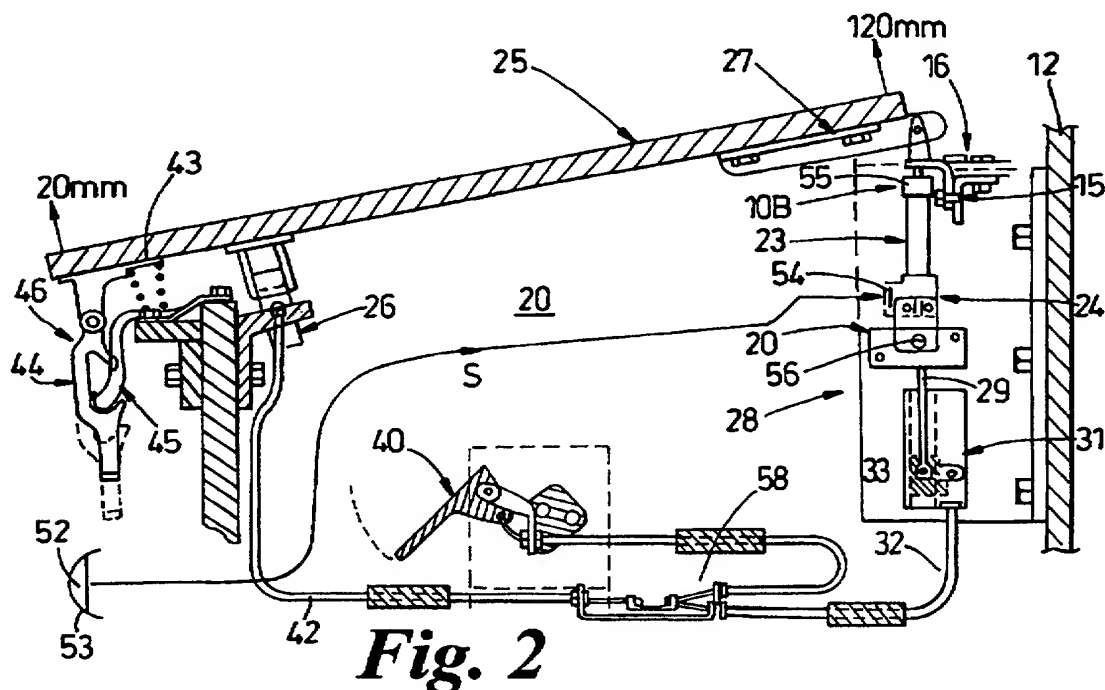
(52) UK CL (Edition V )  
**B7B BSBNC**

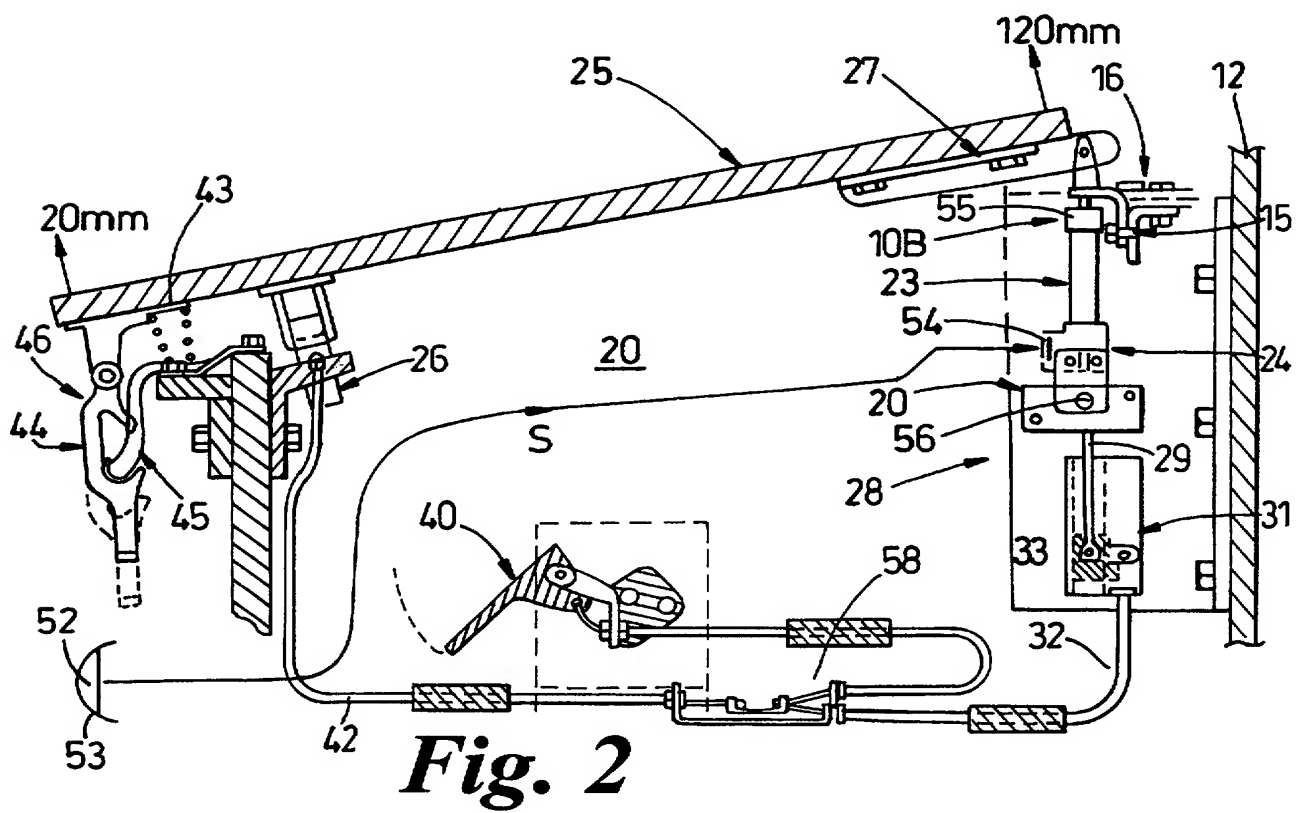
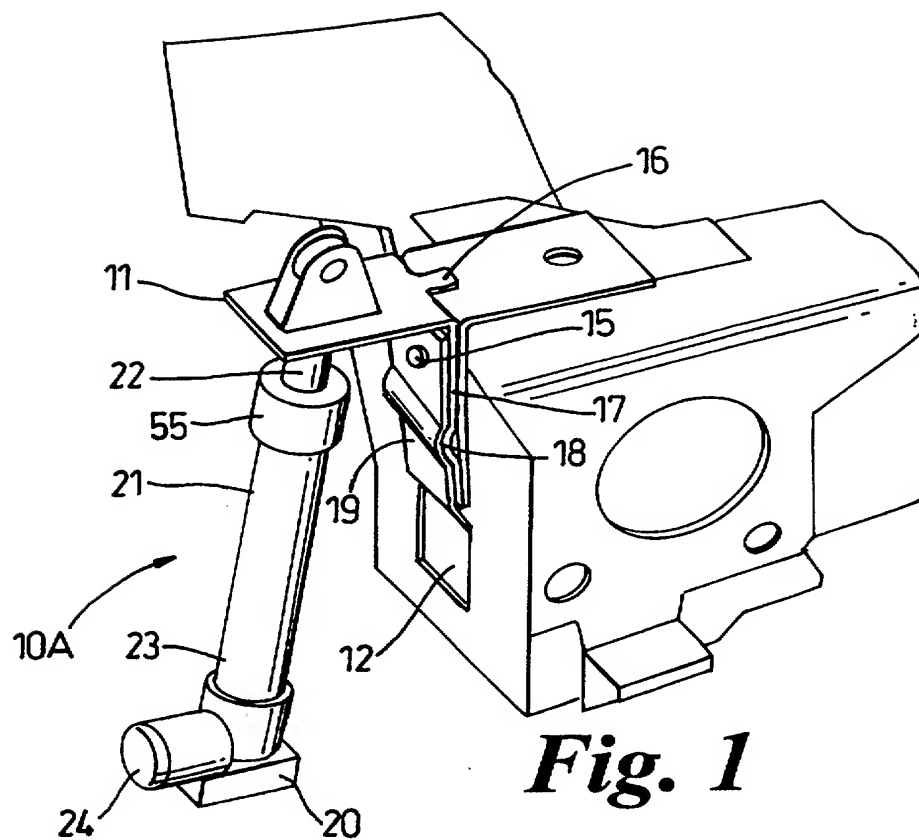
(56) Documents Cited  
**EP 0967128 A2** **US 6217108 A**  
**DE2841315 A**  
**JP110115680A**

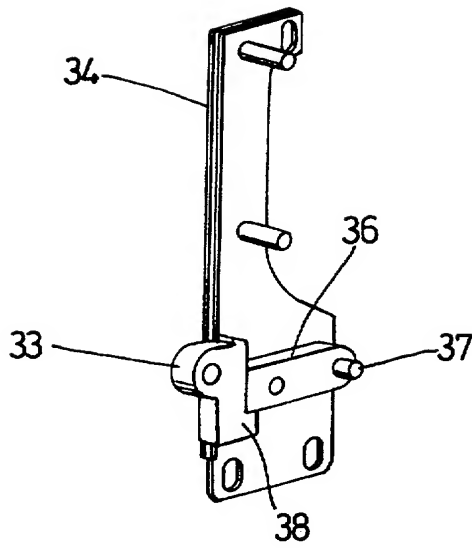
(58) Field of Search  
UK CL (Edition T ) **B7B BSBNC**  
INT CL<sup>7</sup> **B60R 21/34**  
Other: **ONLINE WPI EPODOC JAPIO**

(54) Abstract Title  
**Vehicle bonnet hinge assembly**

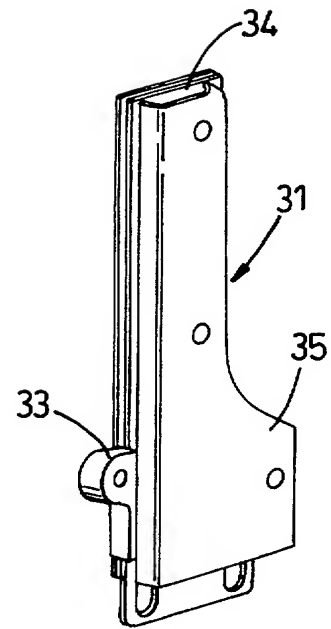
(57) The assembly (10B), for a front bonnet (25) hinged at its rear and latched at the front, includes a hinge mounted to the body through a shear pin (15) and which is connected to a pyrotechnics cylinder assembly (23) fixed to the vehicle body. Operation of the pyrotechnics cylinder assembly (23) moves the piston within the cylinder upwards, shearing the pin (15) and lifting the hinge and the rear of the bonnet. The operation of the pyrotechnics cylinder assembly may simultaneously operate the bonnet release (26) at the front of the bonnet (25).





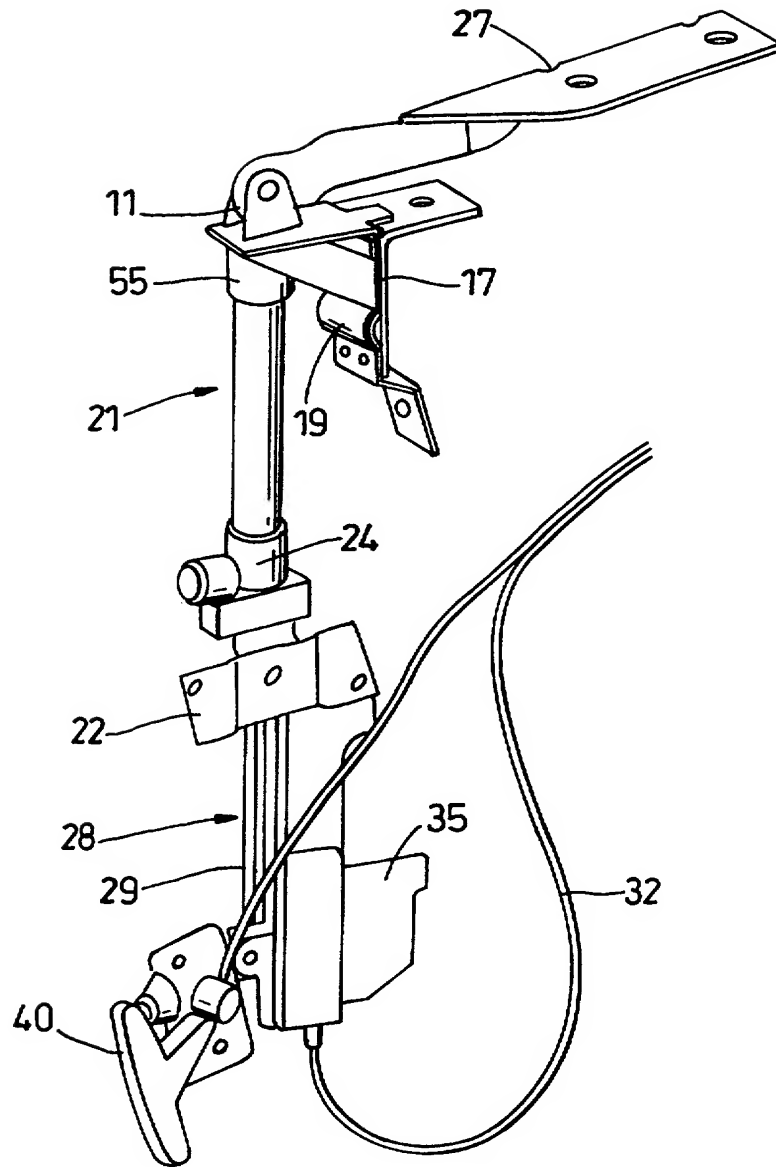


***Fig. 4***



***Fig. 3***

3/3



***Fig. 5***

A Pedestrian Safety Device for Vehicle Bonnet

The invention relates to pedestrian safety devices for use with the front bonnet of a motor vehicle, in particular a motor car.

6

Motor vehicles bodies with front-bonnets constructions have to meet conflicting safety requirements in the event of a frontal impact. The bonnet must be prevented from being pushed through the windscreen opening into the interior of the vehicle which means that the bonnet is held firmly in position. In this instance the energy of impact may be absorbed by deformation of the bonnet so that excessive loads are not placed on the bonnet fixing points e.g. hinge points and latches.

In contrast, if the frontal impact involves a pedestrian, in particular a child, the head of the pedestrian may impact the central and rear areas of the bonnet. In the case of the central area the bonnet may deform so that the pedestrian head impacts against hard engine points under the bonnet and in the case of the rear area the head may impacts against windscreen wiper drive mechanisms.

24

In order to minimize the severity of head injuries to pedestrians it has been proposed that the rear of the bonnet may be lifted during frontal impact with a pedestrian. The Head Impact Criteria (HIC) as devised by

EEVC / WG17 should be as low as possible and preferably less than 1000.

One method of lifting the rear of a bonnet is disclosed in Autoexpress page 12 13th June 2001 and a second method is disclosed in EP-A-0992 419 in which an impact sensor in the front bumper triggers at least one pyrotechnic charge which operates a cylinder which raises the rear of the bonnet so that the deformable areas of the bonnet are raised clear of the engine.

12 The present invention provides a means of lifting the rear of a rear hinged bonnet.

According to the present invention there is provided a hinge assembly for a vehicle front bonnet hinged at its rear and latched at the front, the hinge assembly including a hinge mounted to the body through a load sensitive fixing means and being connected to a cylinder assembly fixed to the vehicle body and comprising a piston reciprocable within a cylinder having a pyrotechnics charged chamber such that in use ignition of the pyrotechnics charge causes movement of the piston within the cylinder, shearing the load sensitive fixing means and lifting the hinge and the rear of the bonnet.

The load sensitive fixing means preferably comprises at least one shear pin and the hinge may further include at least one detent means which engages with a resilient clip

on the vehicle body. This allows the hinge and bonnet to be temporarily re-set in the event of minor damage to the bonnet. The shear pin has sufficient strength for anti-theft purposes.

- 6 The piston is connected to the hinge and the cylinder body is fixed to the vehicle body preferably through a pivot means.

The pyrotechnic chamber which is connected to the piston bore is sealed so that after activation of the pyrotechnic  
12 any gases generated bleed slowly past the piston seal. This ensures that any cylinder assemblies retain pressurized gases for sometime, preferably about 5 minutes, after activation and act as shock absorbers or cushioning devices.

- 18 For a vehicle bonnet, there are preferably a pair of spaced apart hinge assemblies located at the rear of the bonnet adjacent the vehicle A posts. When the rear of the bonnet is raised in some instances the front edge of the bonnet may interfere with the front grill, bumper surfaces, or the head lights. In order to overcome this  
24 problem, one of said hinge assemblies further includes a latch release means for simultaneous release of latch means located at the front of the bonnet.

The latch release means may comprise a connecting rod

having one end attached to the rear of the piston, passing sealingly passing through the pyrotechnics chamber, and having its other end connected to a bonnet release cable.

The rear of the bonnet is preferably lifted vertically by about 120mm which produces a sufficient spacing between the bonnet and engine parts. To accommodate this movement, the connecting rod is connected to the cable through a releasable catch means which detaches from the connecting rod after a predetermined movement. The releasable catch means comprises a detent attached to the connecting rod which is slidable between a pair of guide plates and a resiliently biased catch connected to the cable, the catch being pivoted between the guide plates and being rotatable against the bias to release the detent and pull the cable.

Also according to the present invention there is provided a motor vehicle having a front bumper, a front bonnet hinged at the rear thereof to the vehicle body by a pair of spaced apart hinge assemblies and secured by a latch means at the front, an impact sensor in the front bumper which produces signals indicative of the type of frontal impact, and wherein the hinge assemblies are in accordance with the present invention.

Preferably one of said hinge assemblies further includes a latch release means for simultaneous release of latch means located at the front of the bonnet when the



pyrotechnic chamber is activated.

Yet another aspect of the present invention provides a method of lifting the rear of a vehicle front bonnet, which is hinged at its rear by a pair of spaced hinge  
6 assemblies and has a latch at its front, during a frontal impact with a pedestrian, wherein the impact is sensed by a sensor in the front bumper, signals provided by the sensor are analyzed to determine the type of impact, and on determination of a pedestrian impact the two hinge  
12 assemblies are lifted upwards by actuation of respective cylinder assemblies whose pistons are moved by activation of a pyrotechnics charged chambers by said analyzed signals such that ignition of the pyrotechnics charge causes movement of the piston within the cylinder lifting the hinge assemblies and the rear of the bonnet.

18 Preferably the movement of one of the pistons releases the latch at the front of the bonnet.

The present invention will be described by way of Example only and with reference to the accompanying drawings in which:

- 24 Fig.1 is an isometric drawing of one hinge assembly according to the present invention,  
Fig.2 is a schematic drawing of a vehicle bonnet and a second hinge assembly,  
Fig. 3 is an isometric view of a catch means used

between the bonnet latch and the pyrotechnic chamber connecting rod shown in Fig.2,

Fig. 4 is an internal view of the catch means of Fig.3, and

Fig. 5 is an isometric view of the hinge assembly with bonnet latch release means as shown in Fig. 2.

With reference to Fig.1 and Fig 2, there is shown a hinge assembly 10 for a vehicle bonnet 25 hinged at its rear and latched at its front. The bonnet 25 will be hinged by a pair of spaced apart hinge assemblies 10 A & 10 B located on opposite sides of the vehicle.

One hinge assembly 10A shown in Fig.1, comprises a hinge 11 formed on a "T" shaped bracket 16 having its vertical leg 17 secured to the vehicle body 12 e.g. engine compartment bulkhead, by a load sensitive shear pin 15 with one arm resting on the vehicle body. The hinge also has a detent 18 in the form of an arcuate section rib on the front of its vertical leg 17 below the pin 15. The leg 17 is gripped by an overlying resilient clip 19 mounted on the vehicle body and having a rearwards facing arcuate cavity which accommodates the rib 18. The clip 19 and rib 18 form a resilient snap fit lock.

The hinge 11 is attached to a cylinder assembly 21 pivotally fixed at its lower end to the vehicle body 12 by

a bracket 20, preferably inside the lower A post cavity. The cylinder assembly 21 has a piston 22 attached to the hinge 11 so that upward movement of the piston 22 lifts hinge 11. The piston 22 is reciprocable within a bore in the cylinder body 23 of the assembly and its bore is  
6 connected to a pyrotechnic reaction chamber 24 which is charged with a pyrotechnic material. The cylinder body 23 is closed at its upper end by an end cap 55 and at its lower end by the pyrotechnic chamber 24. The piston 22 passes through the upper end cap 55 for attachment to the hinge 11. The cylinder body bore for the piston has an  
12 internal diameter of about 17mm and the piston is sealed within the bore by rubber "O" rings. The piston stroke is about 120mm.

The pyrotechnic chamber 24 which houses the pyrotechnic material is attached to the vehicle body via a mounting  
18 bracket 20. The preferred pyrotechnic device is a modified Autoliv pyrotechnic device referenced 532-04-57-000 with the standard bleed hole being blocked. The cylinder assembly 21 is connected to the bracket 22 through a pivot pin 56.

24 The second hinge assembly 10B is shown in Figs. 2 and 5, which illustrate the front end portion of a vehicle body having a front bonnet 25 covering the engine compartment 20. The bonnet 25 is connected to the two hinge assemblies 10A & 10B at its rear via hinge leafs 27 and is

secured at its front by a latch means 26 located at the front of the bonnet. The hinge assembly 10B is similar to the assembly 10A and only the differences will be described.

- 6 The hinge assembly 10B further includes a latch release means 28 which includes a connecting rod 29 fixed at one end to the rear of the piston 22 and at its other end to a catch means 31, in turn connected to a bonnet release cable 32. The rod 29 is sealed where it passes through the pyrotechnic chamber 24.

12

- With reference also to Figs. 3 & 4 the catch means 31 comprises a slider 33, a pair of guide plates 34,35, and a resiliently biased catch 36. The slider 33 is pivotally attached to the end of the connecting rod 29 and is guided for vertical sliding movement between the guide plates 18 34,35 which are secured together and mounted to the vehicle body. The catch 36 is mounted between the plates 34,35 by a pivot pin 37 located at its end away from the slider 33 and is biased downwards by a torsion spring to engage a detent 38 on the slider 33. Upward movement of the slider 33 rotates the catch 36 upwards against the 24 spring bias. The catch 36 is connected to the bonnet release cable 32 so that any upward movement of the catch 36 pulls the cable release cable 32. The detent 38 on the slider will dis-engage from the catch 36 as it rotates around the pin 37 so that after about 20mm of vertical

movement the detent completely disengages from the catch 36 and there is no further pull on the cable 32. The piston 22 then completes its full stroke without placing any load on the cable 32.

6 The release cable 32 is in turn connected to the main bonnet release cable 42 which is also connected to the interior bonnet release lever 40 through a divider means 58. This allows for the bonnet to be released by the interior handle 40 in the conventional manner. A pull on cable 32 operates the bonnet release latch 26. On release,  
12 the bonnet front is lifted upwards, for about 20mm, by a spring 43. The upwards movement is limited by a releasable safety hook 44 which engages an abutment 45 in the conventional manner. The upper end of the hook 44 is formed with a recess 46 which engages to top of the abutment 45 to limit downwards movement of the front of  
18 the bonnet.

A collision sensor 52 located in the vehicle front bumper 53 is configured using algorithms so that it passes activating signals S to igniters 54 in the respective pyrotechnic chambers 24 only on front impact with a  
24 pedestrian. This impact detection and signal analysis typically takes place over a 20ms time period.

Only in this event are the two pyrotechnic devices ignited moving the respective pistons 22 upwards and raising the

two hinges 11 the rear of the bonnet 2 by about 120mm in height. This reaction typically takes about 20ms.

The bonnet then settles down over a period of about 20-25ms and the pedestrian may then strike the central  
6 deformable area 14 which is now lifted from the engine, and will not be injured by impact against hard matter under the bonnet.

The initial upwards movement of the hinge 11 of hinge assembly 10B operates the front bonnet release 26 via the  
12 releasable catch means 31 and the front of the bonnet is lifted 20m as the rear is raised. The releasable catch means 31 disengages the connecting rod 29 from the cable 32 and the hinge 11 is lifted with no further pull on the cable. The front of the bonnet may rotate about a pivot formed between the recess 46 on safety hook 44 and the  
18 abutment 45. This process prevents damage due to interference between the bonnet front edge and the car headlights, grille, etc.

On ignition each pyrotechnic chamber develops a peak load of about 8000N over about 2ms and this load thrusts the  
24 piston upwards shearing the pins 15 holding the respective hinges 11 to the vehicle body and dis-engaging the detents 18 from the respective clips 19. The shear pins 15 each break at a load of about 3000N making a total load necessary to shear the pins 15 on both sides of the bonnet

of about 6000N. This load exceeds the recommended anti-theft shear load of about 5000N.

The total elapsed time period for the ignition, pyrotechnic reaction and upwards deployment of the pistons 6 7 and hinges 11 for 120mm, is within about 20ms of ignition. Once deployed, the gas pressure developed within the cylinders then slowly ebbs away past the piston seals over a 5 minute time period. This allows the cylinder assemblies to act as gas springs or cushions for the bonnet.

12

If after the pedestrian frontal impact, the bonnet is not badly damaged then the driver may temporarily re-set the rear of the bonnet to drive the vehicle to a garage for replacement of the shear pins and pyrotechnic devices. The bonnet re-set involves pushing the hinge assemblies 18 10A & 10B downwards until the clips 19 snap over the detents 18 on the hinges 11.

The latch means at the front of the bonnet can be re-set in the normal fashion.

Claims

1. A hinge assembly for a vehicle front bonnet hinged at its rear and latched at the front, the hinge assembly including a hinge mounted to the body through a load sensitive fixing means and being connected to a cylinder  
6 assembly fixed to the vehicle body and comprising a piston reciprocable within a cylinder having a pyrotechnics charged chamber such that in use ignition of the pyrotechnics charge causes movement of the piston within the cylinder, shearing the load sensitive fixing means and lifting the hinge and the rear of the bonnet.
- 12 2. An assembly as claimed in Claim 1 wherein the load sensitive fixing means comprise at least one shear pin.
3. A assembly as claimed in Claim 1 or Claim 2, wherein the hinge has a detent means thereon which is engagable with a  
18 resilient clip on the vehicle body.
4. An assembly as claimed any one of Claims 1 to 3 wherein the piston is connected to the hinge and the cylinder body is fixed to the vehicle body through a pivot means.
- 24 5. An assembly release mechanism as claimed in any one of Claims 1 to 4 wherein the pyrotechnic chamber which is connected to the piston bore is sealed so that after activation of the pyrotechnic gases generated bleed slowly past the piston seal.



6. An assembly as claimed in any one of Claims 1 to 5 and further including a latch release means for simultaneous release of latch means located at the front of the bonnet.
- 6 7. An assembly as claimed in Claim 6, wherein the latch release means comprise a connecting rod having one end attached to the rear of the piston, passing sealingly passing through the pyrotechnics chamber, with its other end connected to a bonnet release cable.
- 12 8. An assembly as claimed in Claim 7 wherein the connecting rod is connected to the cable through a releasable catch means which detaches from the connecting rod after a predetermined movement of the piston.
- 18 9. An assembly as claimed in Claim 8 wherein the releasable catch means comprises a detent attached to the connecting rod which is slidable between a pair of guide plates and a resiliently biased catch connected to the cable, the catch being pivoted between the guide plates and being rotatable against the bias to release the detent and pull the cable.
- 24 10. A motor vehicle having a front bumper, a front bonnet hinged at the rear thereof to the vehicle body by a pair of spaced apart hinge assemblies and secured by a latch means at the front, an impact sensor in the front bumper which produces signals indicative of the type of frontal impact,

and including a pair of hinge assemblies each of which is in accordance with any one of Claims 1 to 12.

11. A motor vehicle as claimed in Claim 10 wherein one of said hinge assemblies is in accordance with one of Claims 6 to 9 for simultaneous release of latch means located at the front of the bonnet when the pyrotechnic chamber is activated.

12. A method of lifting the rear of a vehicle front bonnet hinged at its rear by a pair of spaced hinge assemblies and has a latch at its front, during a frontal impact with a pedestrian, wherein the impact is sensed by a sensor in the front bumper, signals provided by the sensor are analyzed to determine the type of impact, and on determination of a pedestrian impact the two hinge assemblies are lifted upwards by actuation of respective cylinder assemblies whose pistons are moved by activation of a pyrotechnics charged chambers by said analyzed signals, such that ignition of the pyrotechnics charge causes movement of the piston within the cylinder lifting the hinge assemblies and the rear of the bonnet.

13. A method as claimed in Claim 12 wherein the activation of the pyrotechnics charged chambers also releases the front latch.



INVESTOR IN PEOPLE

Application No: GB 0124111.6  
Claims searched: 1-13

Examiner: Roger Binding  
Date of search: 26 January 2002

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): B7B (BSBNC)

Int Cl (Ed.7): B60R 21/34

Other: Online WPI EPODOC JAPIO

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP 0967128 A2 (NISSAN), see Figs 5, 6 and column 6, line 50, to column 7, line 5.	12
X	US 6217108 A (HONDA)	12
X	DE 2841315 A (VW) & WPI Abstract Accession No.1980-D4382C (16), see abstract and drawings.	12
X	JP 110115680 A (NISSAN), WPI Abstract Accession No. 1999-322747 (27) & especially page 7, lines 26 to 36, of computer translation of JP description.	12, 13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.